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FLOOD INSURANCE STUDY

COMPLETED
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ORIGINAL

BOROUGH OF SUGARCREEK, PENNSYLVANIA
VENANGO COUNTY

MAY 16, 1987

Federal Emergency Management Agency

COMMUNITY NUMBER - 420840

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NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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FLOOD INSURANCE STUDY
BOROUGH OF SUGARCREEK, VENANGO COUNTY, PENNSYLVANIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Borough of Sugarcreek, Venango County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by the U. S. Army Corps of Engineers (COE), Pittsburgh District, for the Federal Emergency Management Agency (FEMA), under Contract No. EMW-E-1153, Project Order No. 1, Amendment No. 1. This work was completed in September 1985.

1.3 Coordination

On July 27, 1983, an initial Consultation and Coordination Officer's (CCO) meeting was held with representatives from FEMA, the Borough of Sugarcreek and the COE (the study contractor) to determine the streams to be studied by detailed methods. Coordination of this study involved Notice of Initiation letters, public meetings, and incidental meetings with borough officials. Notice of Initiation of study letters dated December 1, 1983, announced the start of the study and were sent to all Federal, State, County, and local government agencies and private firms that could make input to the study.

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On June 25, 1986, a final CCO meeting was held with representatives of FEMA, the borough, and the study contractor to review the results of the study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Borough of Sugarcreek, Venango County, Pennsylvania. The area of study is shown on the Vicinity Map (Figure 1).

The Allegheny River, Sugar Creek, and French Creek were studied by detailed methods for their entire lengths within the community. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through September 1990.

Warden Run, Foster Run, Beatty Run, Wolf Run, Patchel Run, Twomile Run, and Read Run were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the Borough of Sugarcreek.

2.2 Community Description

The Borough of Sugarcreek is located in northeastern Venango County in northwestern Pennsylvania. The total land area contained within the borough is 39.7 square miles. The borough is bordered by the Townships of Jackson and Oakland to the north; the Township of Cornplanter and the City of Oil City to the east; the Townships of French Creek, Cranberry, and Reno, and the City of Franklin to the south; and the Township of Canal to the west. According to the U. S. Bureau of the Census, the population of the Borough of Sugarcreek was 5,954 in 1980, a 0.17 percent increase from the 1970 population of 5,944 in 1970 (Reference 1).

The Allegheny River, with a total drainage area of 11,778 square miles at its mouth, joins the Monongahela River to form the Ohio River at Pittsburgh, Pennsylvania. The headwaters of the Allegheny River are in the western slopes of the Appalachian Mountain Range in Potter County in northwestern Pennsylvania. It flows in a northwestern direction from its source until it reaches Portville, New York, near the New York-Pennsylvania border. It then flows west to Salamanca, New York, and southward into Pennsylvania to its mouth at Pittsburgh, a total distance of 322 miles. The average river gradient of the river in the community is 3.6 feet per mile. Local relief above the stream valley varies from a low of 990 feet to an average hilltop elevation of 1,500 feet.

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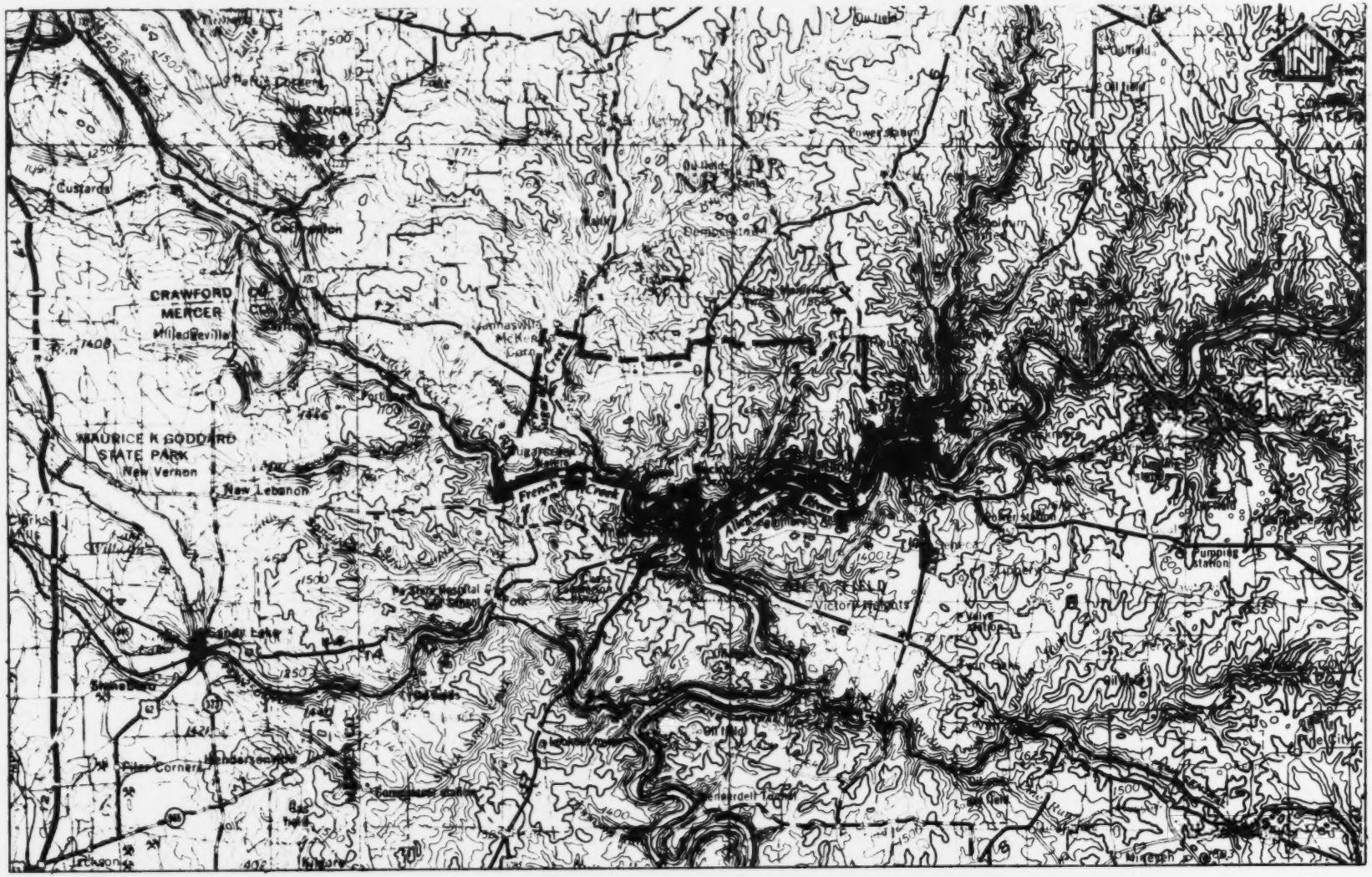

FEDERAL EMERGENCY MANAGEMENT AGENCY

BOROUGH OF SUGARCREEK, PA

(VENANGO CO.)

FIGURE 1

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

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Sugar Creek, with a total drainage area of 166.7 square miles at its mouth, joins French Creek at Sugarcreek, Pennsylvania, approximately 4.5 miles upstream of the mouth of French Creek. Sugar Creek flows in a generally southern direction from its source near Townville, Pennsylvania, to its mouth, a total distance of 22 miles. The average gradient of the stream within the community is 18 feet per mile. Local relief varies from a low of 1,000 feet to an average hilltop elevation of 1,500 feet.

French Creek, with a total drainage area of 1,235 square miles at its mouth, joins the Allegheny River at the City of Franklin. The headwaters of French Creek are in a state of reforestation along the border of the Townships of Sherman and North Harmony, Chautauqua County, New York. The stream flows in a generally southwestern direction from its source to Meadville, Pennsylvania. It then flows in a generally southeast direction to its confluence with the Allegheny River, a total distance of 107 miles. The average gradient of French Creek in the community is 4 feet per mile. Local relief above the stream valley varies from a low of 990 feet to an average hilltop elevation of 1,500 feet.

The climate for this area is temperate with seasonal variation in temperature. The borough is geographically located in a region of both polar and tropical air mass activity, subjected to continental and maritime invasion. The weather is usually moderate but may have occasional rapid changes resulting from frontal air mass movements. Temperatures range from an average of 27 degrees Farenheit (°F) in February to an average of 71 °F in July. Measurable precipitation occurs on an average of 150 days a year and amounts to an annual average of 40 inches.

2.3 Principal Flood Problems

Major floods have occurred in the area around the Allegheny River and French Creek at various times of the year; however, the main flood season is usually December through April. Most floods during this period are the result of heavy rain and snowmelt. Although summer floods are rare on the Allegheny River and French Creek, the June 1972 flood was of considerable magnitude in spite of the reduction from the upstream flood control dams and reservoirs.

The maximum flood of record along the Allegheny River in the borough occurred in March 1865. The most recent flood occurred in June 1972 as a result of Hurricane Agnes. If the upstream reservoir system had not been in place, the June 1972 flood heights would have been approximately 7.5 feet higher than recorded and only 1.6 feet lower than the March 1865 flood. The following tabulation shows major floods on the Allegheny River as measured at the U. S. Geological Survey (USGS) gaging station at Franklin, Pennsylvania at stream mile 123.77.

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Date of Crest	Stage (feet)	Elevation (feet)	Discharge (cfs)
March 18, 1865	25.00[1]	980.92	196,000
March 26, 1913	24.60	980.52	192,000
March 13, 1920	20.65	976.51	134,000
March 09, 1956	20.55[2]	976.47	133,100
March 22, 1948	20.36[2]	976.28	130,700
March 29, 1914	19.60	975.52	121,500
December 1, 1927	19.38	975.30	119,100
March 29, 1916	19.10	975.02	115,500
April 06, 1947	19.05[2]	974.97	114,900
March 28, 1936	19.02	974.94	114,500

[1]Estimated.
[2]Includes partial reduction from present reservoir system.
NOTE: Gage zero equals 955.84 feet.

The maximum flood of record on French Creek within the borough occurred in March 1913. The most recent flood occurred in February 1981. The upstream reservoirs reduced the peak flood stage by 1.3 feet. The following tabulation shows major floods of record as measured at the USGS gaging station located 0.6 mile upstream of Sugarcreek in Utica.

Date of Crest	Stage (feet)	Elevation (feet)	Discharge (cfs)
March 27, 1913	15.9	1,034.7	35,600
March 20, 1929	13.8	1,033.3	26,600
March 14, 1920	13.3	1,032.8	25,000
March 29, 1916	13.1	1,032.6	24,100
February 21, 1981	11.6[1]	1,031.2	18,320

[1]Includes partial reduction from present reservoir system.
NOTE: Gage zero equals 1,019.44 feet.

Major floods may occur on Sugar Creek at various times of the year. However, the highest known floods as recorded at the USGS gaging station have occurred in the months of May and June. This stream appears to be more susceptible to flash flooding from intense short duration thunderstorms rather than winter-spring precipitation combined with snowmelt, although this type of flooding does occur. The maximum known flood, and the most recent along Sugar Creek, occurred in June 1981. This storm has an approximate recurrence interval of a 30-year event. The following tabulation shows major floods of record on Sugar Creek at the USGS gaging station at Sugarcreek, approximately 1.4 miles upstream of the mouth.

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Date of Crest	Stage (feet)	Elevation (feet)	Discharge (cfs)
June 27, 1981	11.03[1]	1,023.45	11,500
May 28, 1946	8.49	1,020.45	10,500
January 21, 1959	-	-	9,600
October 16, 1954	9.20[2]	1,021.62	9,480
February 17, 1976	11.38[2]	-	8,250

[1]Gage heights from high-water marks.
[2]Gage height affected by ice.
NOTE: Gage zero equals 1,012.42 feet.

2.4 Flood Protection Measures

There are two flood control dams and reservoirs in the Allegheny River basin upstream of the Borough of Sugarcreek that are effective in reducing flood levels. The present reservoir system reduces flood crests by approximately 2.5 to 6 feet. They are located on the Allegheny River upstream of the confluence of French Creek in Franklin and control 56 percent of the drainage area.

On French Creek, there are two flood control dams and reservoirs that are effective in reducing flood heights within the Borough of Sugarcreek. They control approximately 26 percent of the drainage area upstream of Utica and reduce major flood crests by 1 to 2 feet. The following tabulation presents pertinent data for the four flood control projects.

Dam and Reservoir	Location[1] (miles)	Drainage Area (square miles)	Date Place In Operation
Tionesta Dam Tionesta Lake	35	473	December 1940
Kinzua Dam Allegheny Reservoir	80	2,180	January 1967
Union City Dam Union City Reservoir	70	222	October 1970
Woodcock Creek Dam Woodcock Creek Lake	34	46	January 1974

[1]Miles upstream of downstream corporate limits of the Borough of Sugarcreek.

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At the present time there are no flood protection structures on Sugar Creek, and there are no plans for such structures in the foreseeable future.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

Natural discharge-frequency curves on the Allegheny River were developed following the standard log-Pearson Type III analysis as outlined in the USGS Bulletin No. 17B (Reference 2). The stage discharge records used in the analysis of the river were obtained at the USGS gaging station in Franklin covering a 79-year period. Flood flow frequencies developed at the gaging station were modified by means of an average reduction curve to reflect the reduction caused by the upstream flood control structures.

The frequency analysis for Sugar Creek and French Creek utilized gaging stations in the French Creek basin and an average reduction curve for the Utica gage. The historical flood records for the French Creek and Sugar Creek gaging stations were analyzed by a log-Pearson Type III analysis for natural conditions (Reference 2). The peak discharges for French Creek were then adjusted for upstream regulation by using an average

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reduction curve at Utica. These adjusted flows were used upstream of the mouth of Sugar Creek. The flood peak discharge for the selected recurrence intervals on French Creek and Sugar Creek were then combined to produce flood flows at the mouth of French Creek. These flows were originally developed for the City of Franklin Flood Insurance Study (Reference 3). Gages used in the hydrologic analysis for this study are shown in the following tabulation:

Gage No.	Source	Location	Period of Record
3024000	French Creek	Utica, PA	1932-1975
3025000	Sugar Creek	Sugarcreek, PA	1932-1979
3025500	Allegheny River	Franklin, PA	1914-1985

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods are shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
ALLEGHENY RIVER					
Just upstream of confluence with French Creek	4,747	59,900	76,800	82,600	105,300
SUGAR CREEK					
At confluence with French Creek	166.7	9,000	12,300	13,800	17,200
FRENCH CREEK					
At confluence of Sugar Creek	1,235	26,600	37,000	42,000	52,000
Just upstream of confluence with Sugar Creek	1,028	19,800	27,500	32,500	39,800

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

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Cross section data for the segments of the Allegheny River were obtained by field surveys. Cross sectional data for French Creek and Sugar Creek were obtained from topographic maps compiled from aerial photographs at a scale of 1:4,800 with a contour interval of 4 feet (Reference 4). All bridges and culverts were field surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 5). Flood profiles were drawn showing computed water- surface elevations for floods of the selected recurrence intervals.

Starting water-surface elevations on the Allegheny River were based on stage-discharge relationships at the downstream corporate limits. They were obtained by a continuation of profile computations, which started at the confluence of the Allegheny River with the Ohio River in Pittsburgh, Pennsylvania, and high-water marks. Starting water-surface elevations on Sugar Creek were based on coincidental flooding with French Creek. Starting water-surface elevations for French Creek were obtained from a continuation of profiles developed for the City of Franklin Flood Insurance Study (Reference 3).

Channel and overbank roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and were based on field observations of the stream and flood plain areas. Manning's "n" values for the Allegheny River, Sugar Creek, and French Creek were chosen on the basis of field inspection to reproduce profiles for known floods for which high-water marks were obtained and flow quantities were measured or easily calculated. For the Allegheny River, the channel "n" value was 0.080, and the overbank "n" values ranged from 0.058 to 0.181; the well-defined flood of June 1972 and the moderate flow of March 1984 were successfully reproduced using those coefficients. For Sugar Creek, the channel "n" values ranged from 0.045 to 0.060, and the overbank "n" values ranged from 0.080 to 0.400; the flood of June 1981 was successfully reproduced using those coefficients. Roughness coefficients for French Creek ranged from 0.375 to 0.070, and the overbank "n" values ranged from 0.045 to 0.080 and were chosen by successfully reproducing the stage-discharge rating curve for the recording gage located at Utica.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

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All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year flood plain boundaries and 100-year floodway to assist communities in developing flood plain management measures.

4.1 Flood Plain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the streams studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:4,800 with a contour interval of 4 feet (Reference 4).

For the streams studied by approximate methods, the 100-year flood boundaries were delineated using field investigations and topographic maps (Reference 4).

The 100- and 500-year flood plain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year flood plain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE), and the 500-year flood plain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 100-year flood plain boundary is shown on the Flood Insurance Rate Map (Exhibit 2).

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4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the flood plain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 2). The computed floodways are shown on the Flood Insurance Rate Map (Exhibit 2). In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary is shown. Portions of the floodway widths for the Allegheny River and French Creek extend beyond the corporate limits.

The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY	INCREASE
Allegheny River								
A	124.38[1]	1392/1385[4]	17,296	4.8	977.5	977.5	977.5	0.0
B	126.00[1]	811/760[4]	17,374	4.8	980.6	980.6	980.7	0.1
C	128.00[1]	702/672[4]	10,437	7.9	985.0	985.0	985.0	0.0
D	129.38[1]	776/698[4]	16,524	5.0	989.2	989.2	989.2	0.0
French Creek								
A	17,610[2]	647/540[4]	9,275	4.5	1,003.6	1,003.6	1,004.6	1.0
B	22,000[2]	421/268[4]	6,529	6.4	1,010.7	1,010.7	1,011.4	0.7
C	26,460[2]	299/137[4]	5,008	6.5	1,014.8	1,014.8	1,015.7	0.9
D	30,790[2]	243/126[4]	4,417	7.4	1,019.1	1,019.1	1,020.1	1.0
E	35,160[2]	432/120[4]	7,603	4.3	1,022.0	1,022.0	1,023.0	1.0
F	39,110[2]	348/172[4]	6,724	4.8	1,025.1	1,025.1	1,026.0	0.9
Sugar Creek								
A	1,220[3]	344	2,617	5.3	1,014.3	1,014.3	1,015.0	0.7
B	4,380[3]	815	3,760	3.7	1,023.7	1,023.7	1,024.6	0.9
C	7,368[3]	265	1,812	7.6	1,033.9	1,033.9	1,034.8	0.9
D	12,698[3]	1,577	9,892	1.4	1,053.1	1,053.1	1,054.0	0.9
E	16,468[3]	234	2,118	6.4	1,065.3	1,065.3	1,065.8	0.5
F	21,375[3]	400	2,635	5.2	1,082.0	1,082.0	1,082.0	0.0
G	25,245[3]	550	3,644	3.7	1,089.8	1,089.8	1,090.8	1.0

[1]Miles above confluence with Ohio River
[2]Feet above confluence with Allegheny River
[3]Feet above confluence with French Creek
[4]Width/width within corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

BOROUGH OF SUGARCREEK, PA
(VENANGO CO.)

FLOODWAY DATA

ALLEGHENY RIVER - FRENCH CREEK - SUGAR CREEK

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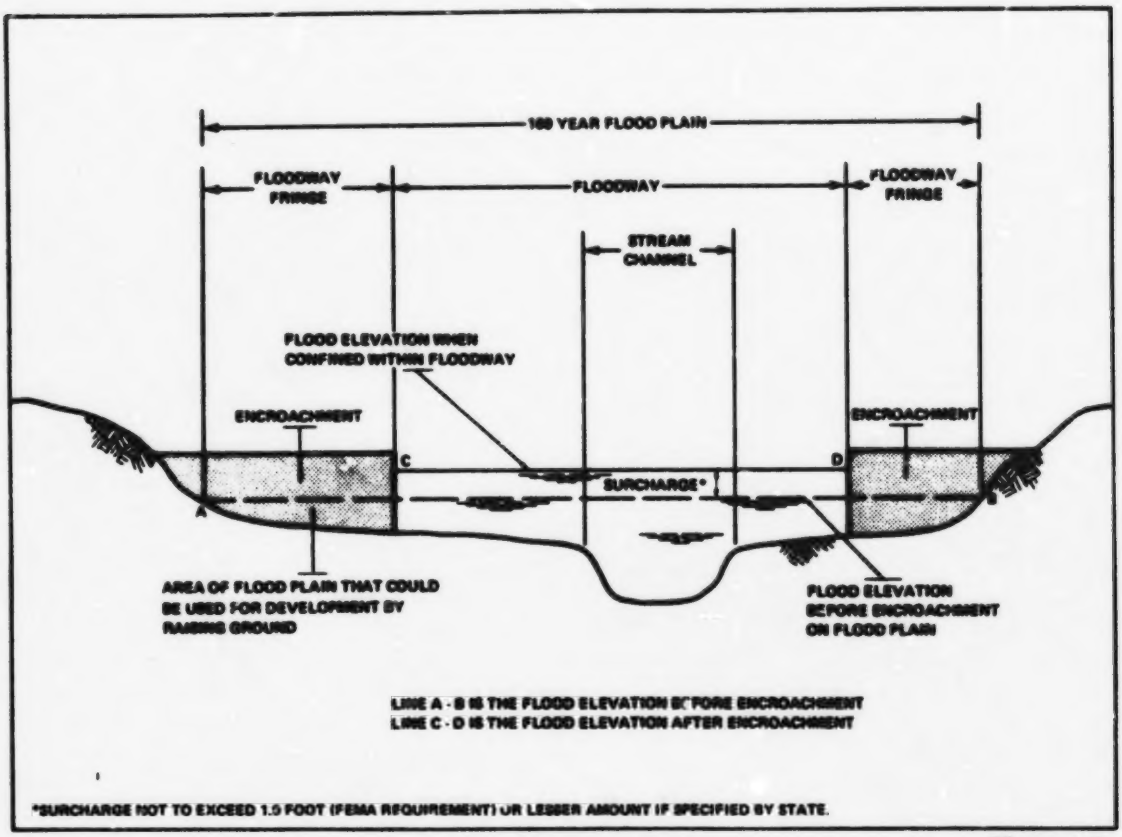
100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC

Figure 2

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year flood plains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year flood plains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

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Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year flood plain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal flood plains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal flood plains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year flood plain, areas within the 500-year flood plain, and to areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

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Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and flood plain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year flood plains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For flood plain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year flood plains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

7.0 OTHER STUDIES

The COE published a Flood Plain Information Report for Venango County, Pennsylvania (Reference 6). That report concerns flooding of the Allegheny River.

Flood Insurance Studies for the Cities of Franklin and Oil City have been published (References 3 and 7). The results of this study are in agreement with the results of those studies.

Flood Insurance Studies for the Townships of Frenchcreek and Cranberry are currently being prepared (References 8 and 9). The results of those studies will be in exact agreement with the results of this study.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Liberty Square Building (Second Floor), 105 South Seventh Street, Philadelphia, Pennsylvania 19106.

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9.0 BIBLIOGRAPHY AND REFERENCES

1. U. S. Department of Commerce, Bureau of the Census, 1980 Census of Population, Number of Inhabitants, Pennsylvania, Washington, D. C., U. S. Government Printing Office, 1981.

2. U. S. Department of the Interior, Geological Survey, Office of Water Data Collection, Interagency Advisory Committee on Water Data, "Guidelines for Determining Flood Flow Frequency," Bulletin 17B, Reston, Virginia, Revised September 1981.

3. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, City of Franklin, Venango County, Pennsylvania, Washington, D. C., September 29, 1978.

4. Michael Baker, Jr., Inc., of Beaver, Pennsylvania, Topographic Maps compiled from aerial photographs, Scale 1:4,800, Contour Interval 4 Feet: Sugarcreek, Pennsylvania, Flown in February 1984.

5. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Generalized Computer Program, Davis, California, October 1973.

6. U. S. Army Corps of Engineers, Pittsburgh District, Flood Plain Information Report, Venango County, Pennsylvania, Pittsburgh, Pennsylvania, 1974.

7. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, City of Oil City, Venango County, Pennsylvania, Washington, D. C., July 5, 1977.

8. Federal Emergency Management Agency, Flood Insurance Study, Township of Frenchcreek, Venango County, Pennsylvania (Unpublished).

9. Federal Emergency Management Agency, Flood Insurance Study, Township of Cranberry, Venango County, Pennsylvania (Unpublished).

Water Resources Council, Flood Plain Management Guidelines for Implementing Executive Order 11988, Washington, D. C., February 1978.

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EXHIBIT 3 - ELEVATION REFERENCE MARKS

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 1	05	1,017.02	Cut U in south headwall two feet from west edge of stone box culvert 12 feet south of CONRAIL tracks, 146 feet west of mile post 19 along north side of French Creek.
RM 2	05	1,006.15	USC & GS disk set in top of concrete post 20 feet south of U. S. Route 322 centerline, 3.4 miles northwest from Franklin courthouse.
RM 3	05	1,013.16	Brass disk marked U. S. Engineering Department No. 201-1935 in top of southwest headwall 5 feet south of tracks on bridge over Sugar Creek.
RM 4	05	1,025.58	Cut L in upstream concrete abutment of Sugar Creek Road over Sugar Creek.
RM 5	10	1,001.87	Brass disk stamped elevation 1,000 feet, set in northeast wing wall of U. S. Route 322 bridge over Patchel Run tributary to French Creek, 2.8 miles northwest of Franklin courthouse.
RM 6	10	998.61	Cut U in top of backwall of catch basin .6 mile east of Franklin corporate limits across from Bonanza Restaurant on southside of State Route 8.

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EXHIBIT 3 - ELEVATION REFERENCE MARKS - continued

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 7	10	990.68	Standard disk stamped K-85 Reset 1955 33.6 feet northwest of centerline of State Route 62 bridge over Twomile Run.

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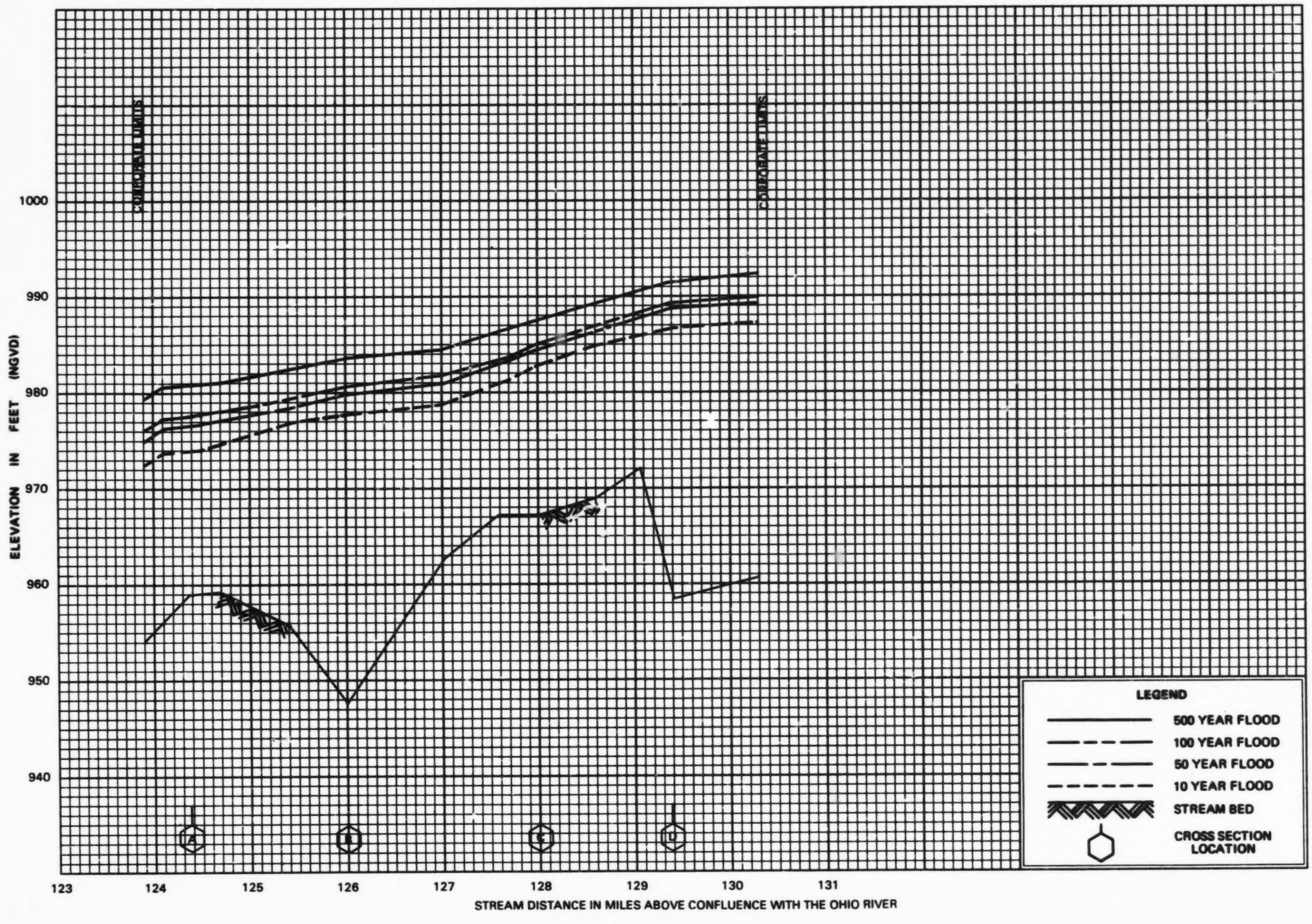

FLOOD PROFILES

ALLEGHENY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BOROUGH OF SUGARCREEK, PA

(VENANGO CO.)

01P

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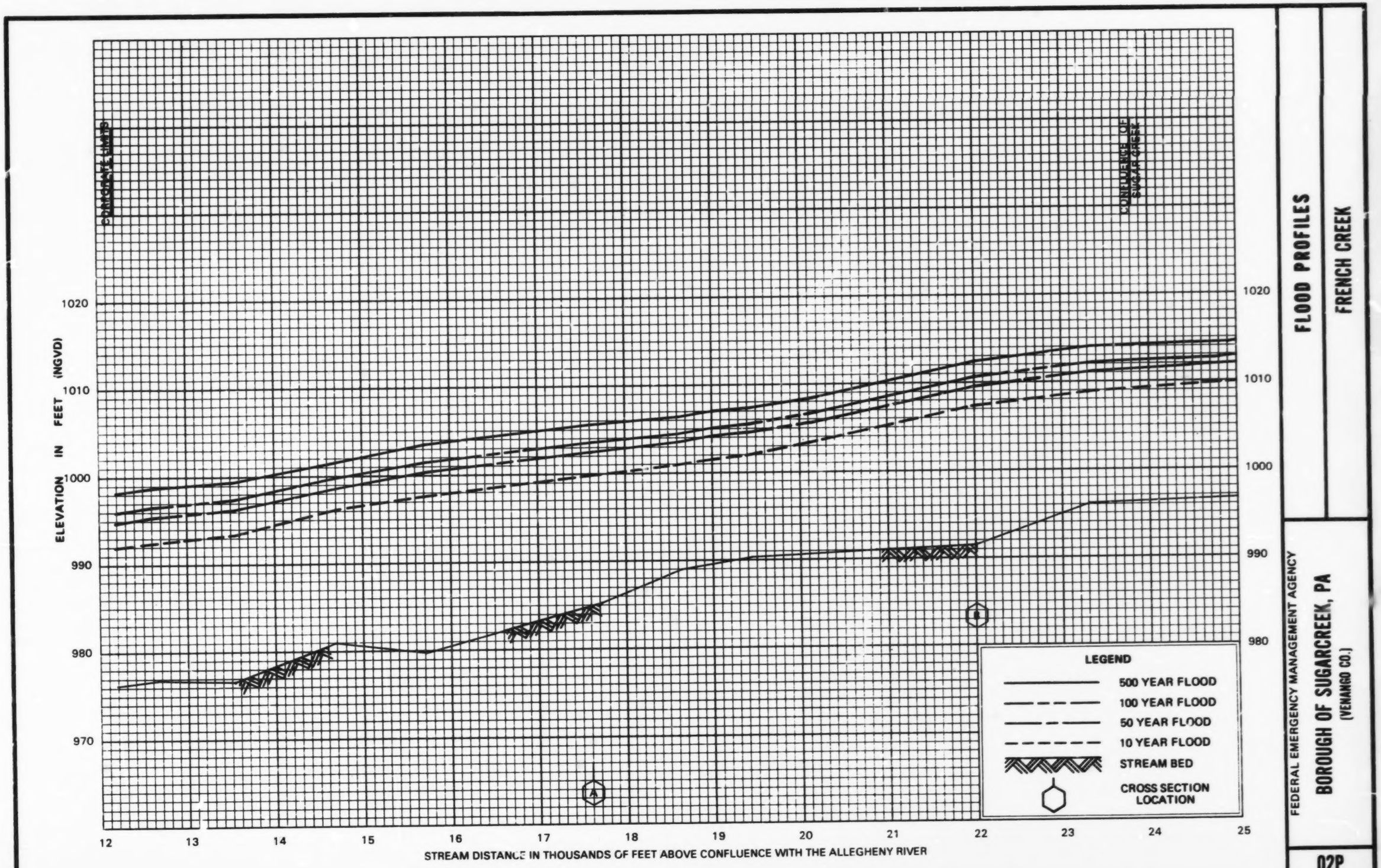

FLOOD PROFILES

FRENCH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BOROUGH OF SUGARCREEK, PA

(VENANGO CO.)

02P

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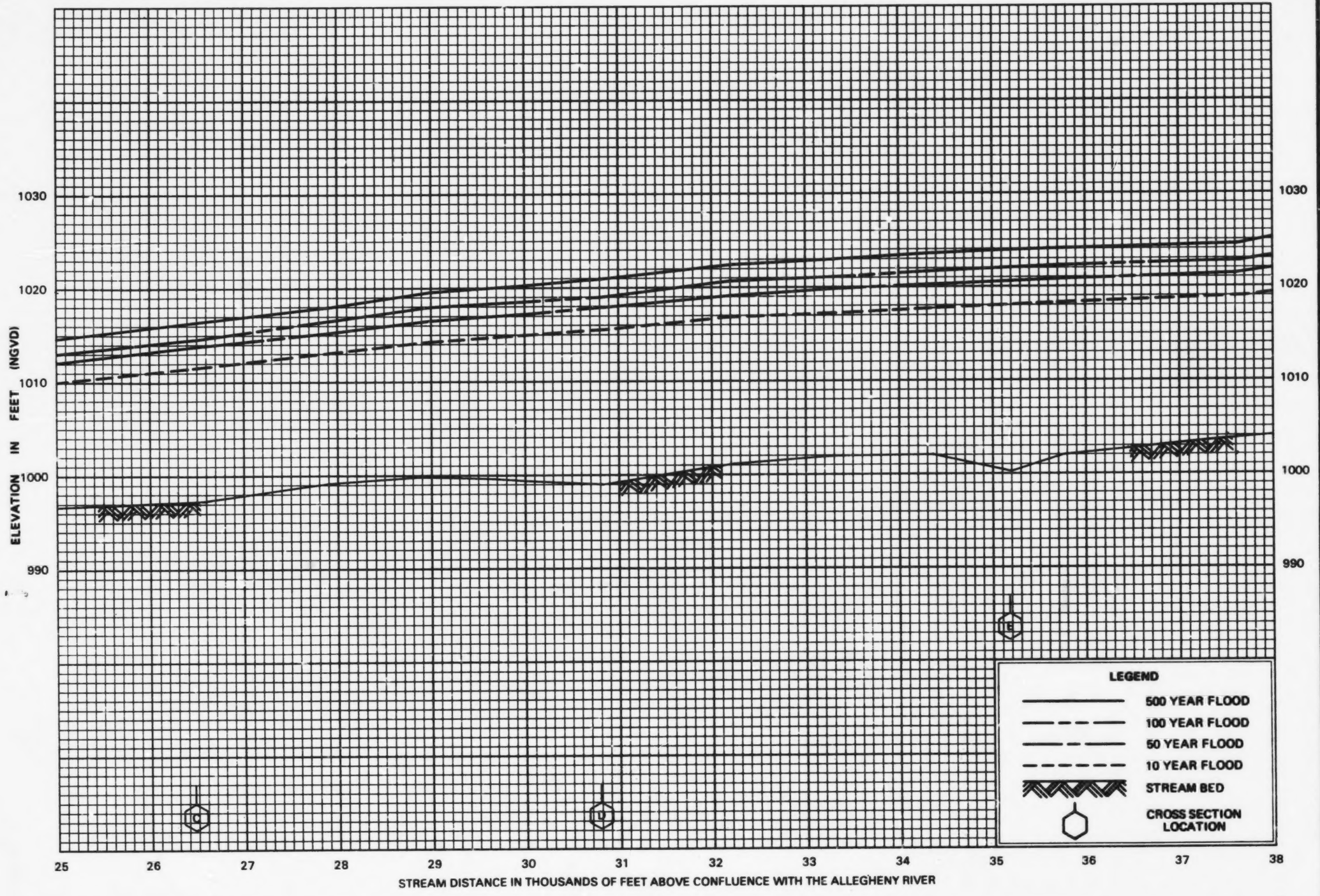

FLOOD PROFILES

FRENCH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BOROUGH OF SUGARCREEK, PA

(VENANGO CO.)

03P

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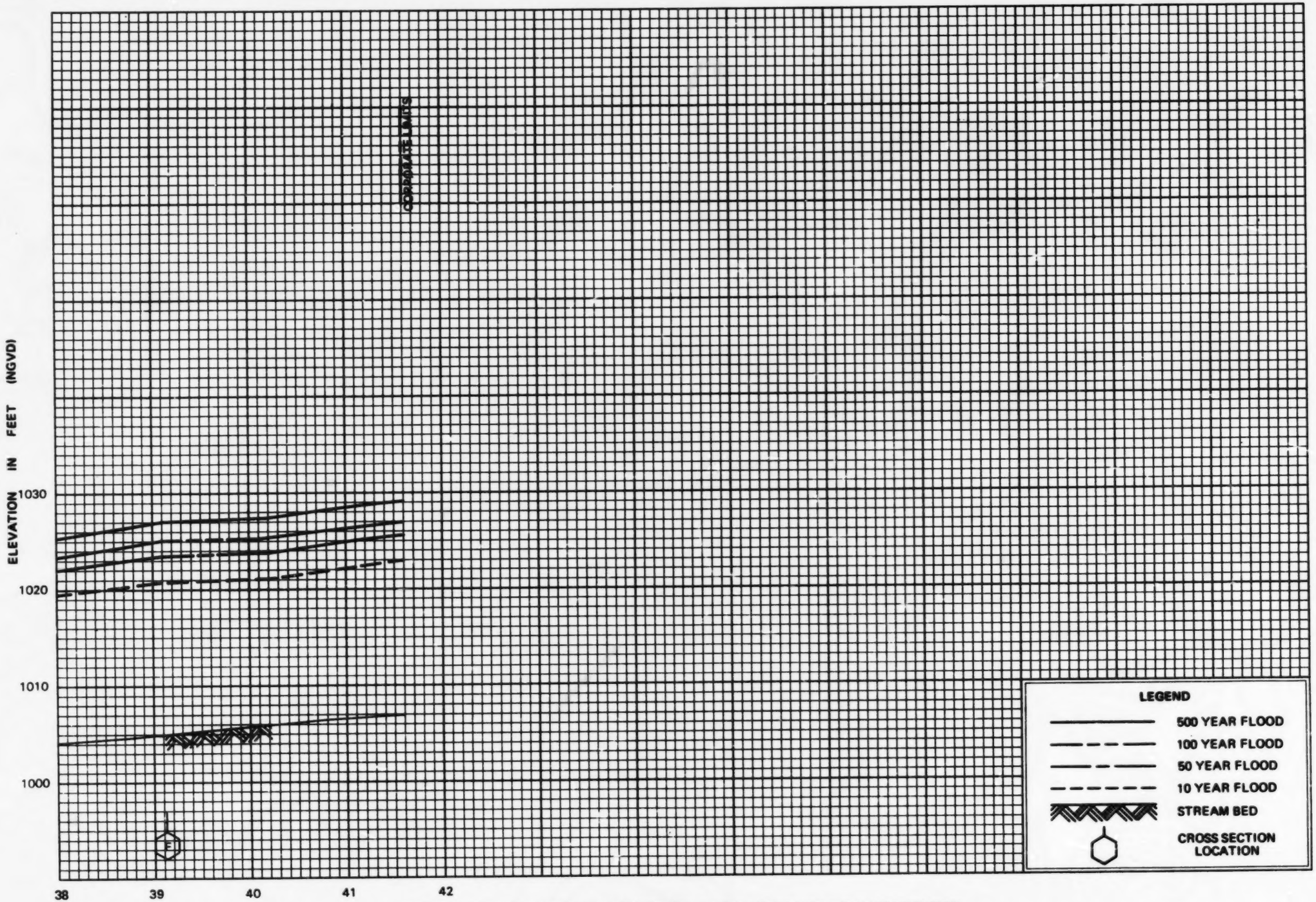

FLOOD PROFILES

FRENCH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BOROUGH OF SUGARCREEK, PA
(VENANGO CO.)

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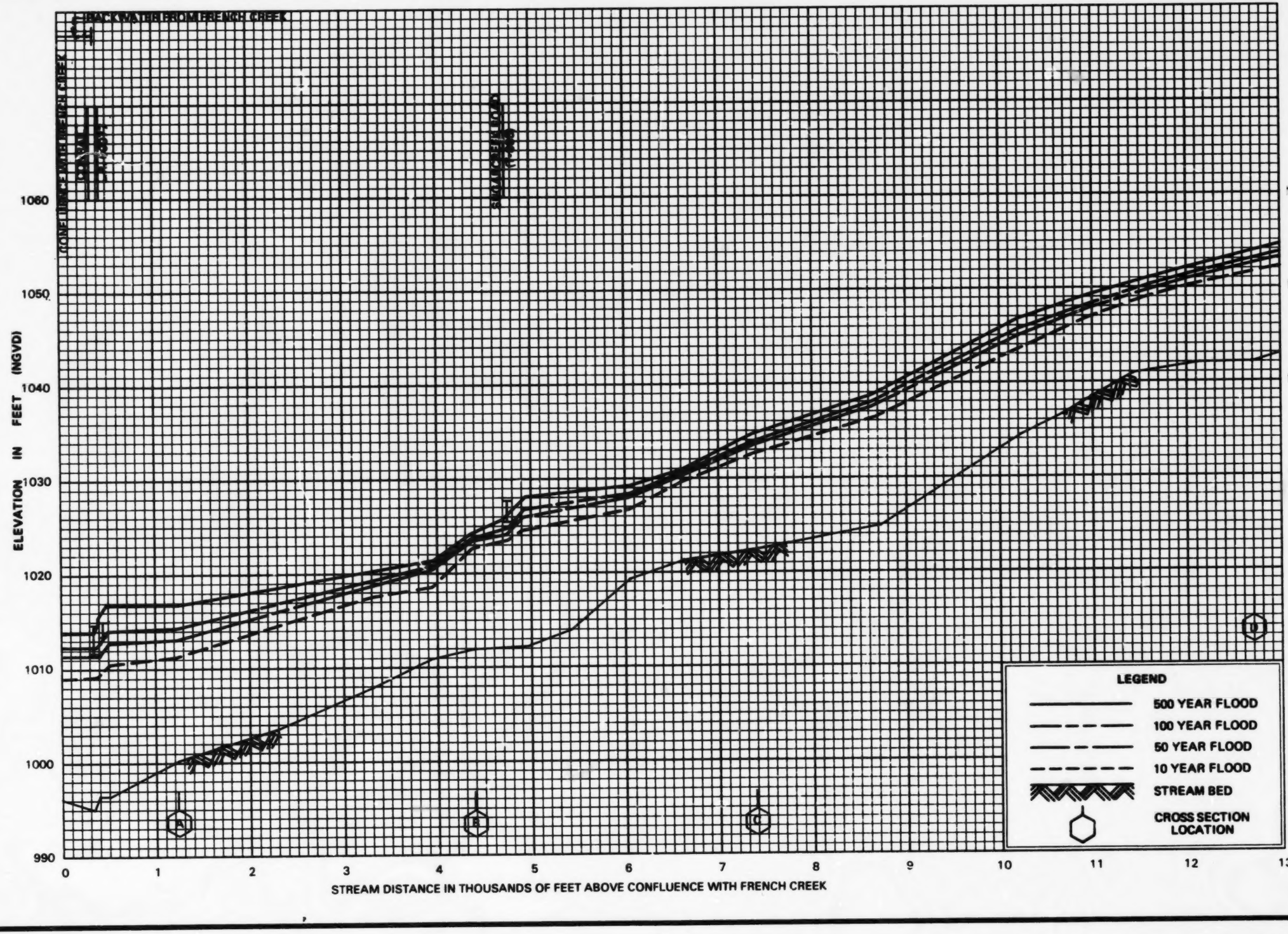

FLOOD PROFILES

SUGAR CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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(VENANGO CO.)

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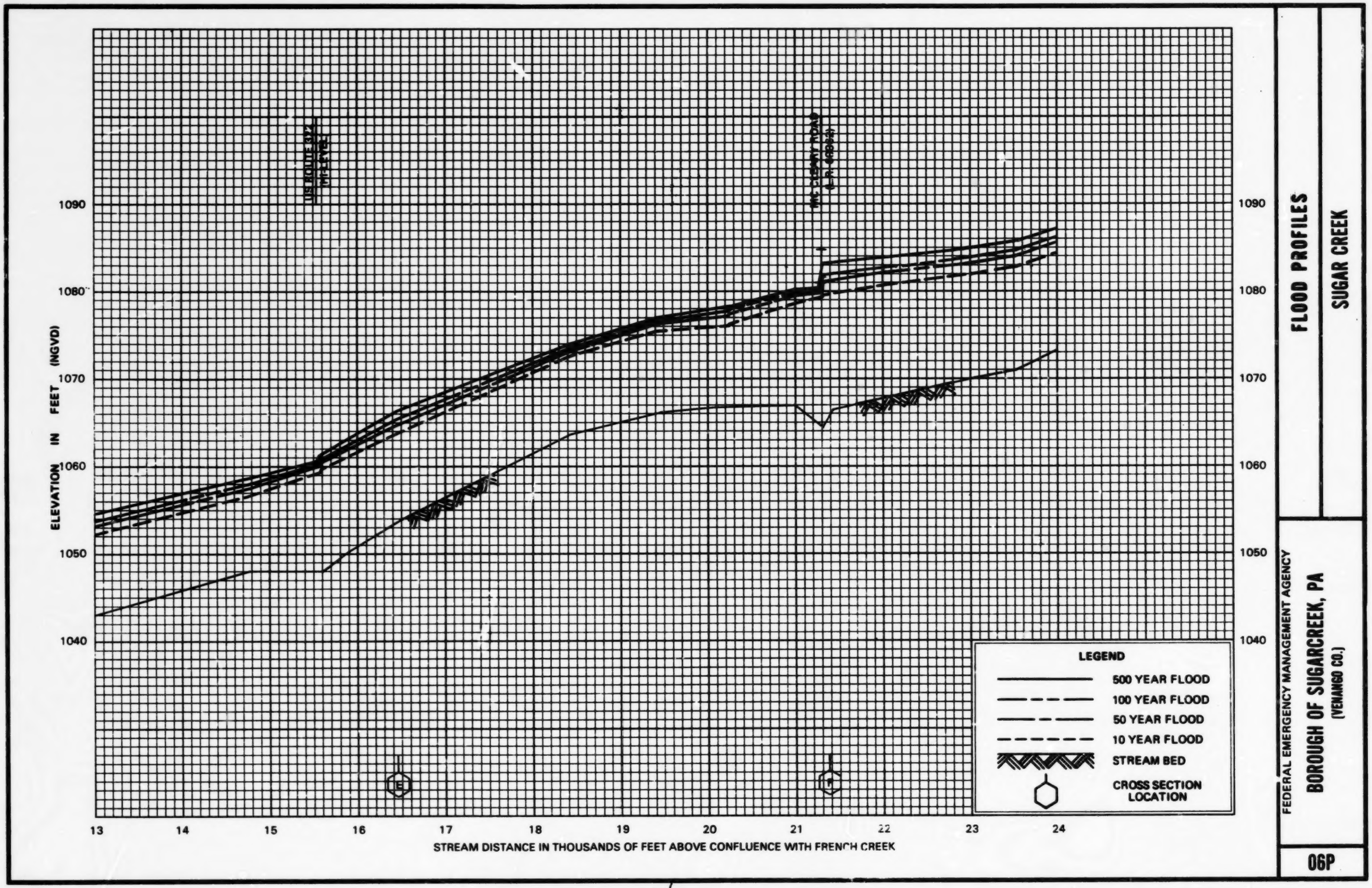

FLOOD PROFILES

SUGAR CREEK

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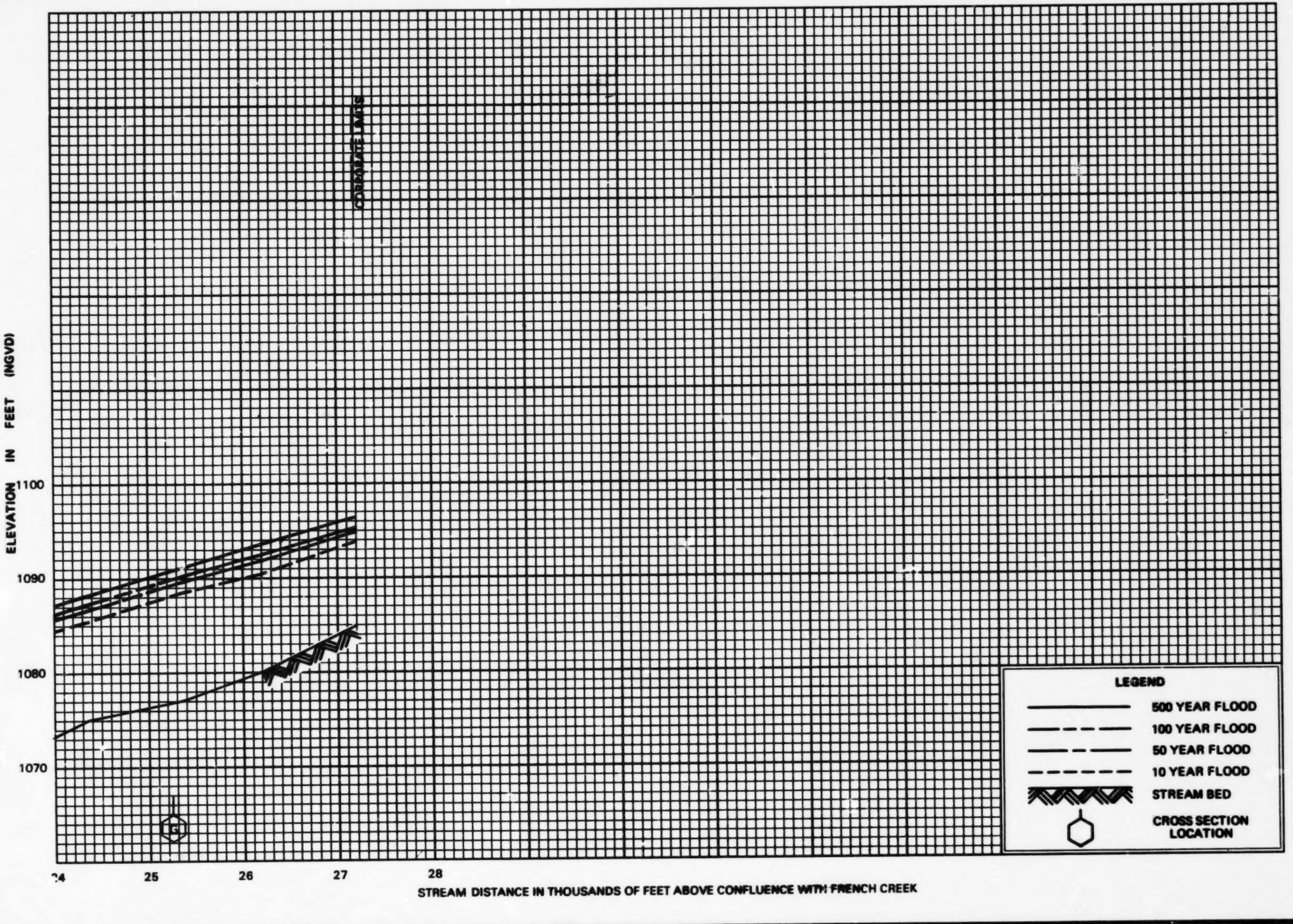

FLOOD PROFILES

SUGAR CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BOROUGH OF SUGARCREEK, PA
(VENANGO CO.)

07P

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